# ALEPH Status Report

## LEPC - July 20 2000

Gary Taylor, UC Santa Cruz

SM processes

Higgs searches

SUSY searches

# *Detector performance*

Detector working very well, data quality is high

DAQ efficiency = 95.4%

Background conditions are good

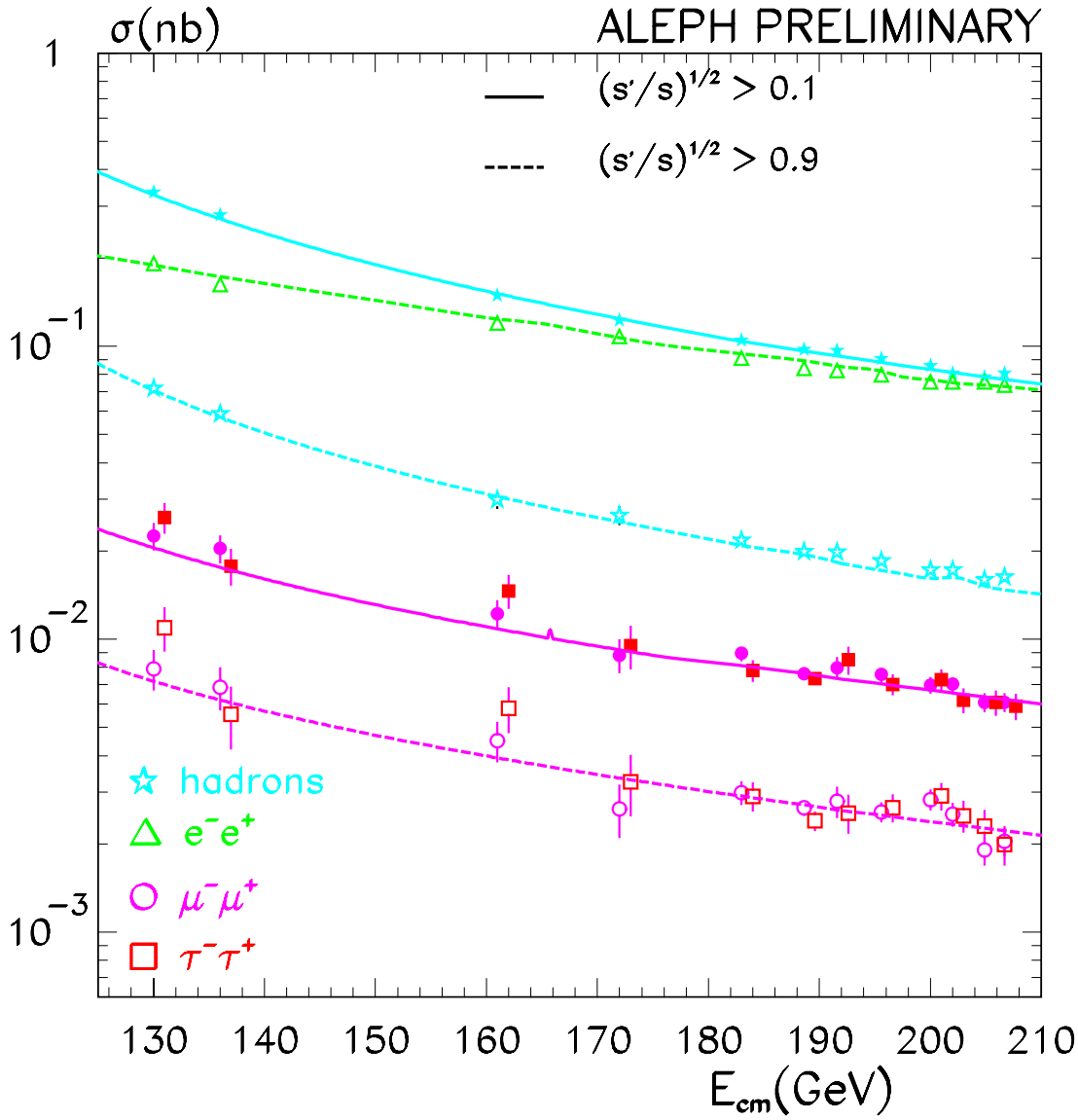
Results based on 92.7 $pb^{-1}$ @ 203-208 GeV

61.5 $pb^{-1}$ @ 204.9 GeV
31.2 $pb^{-1}$ @ 206.7 GeV

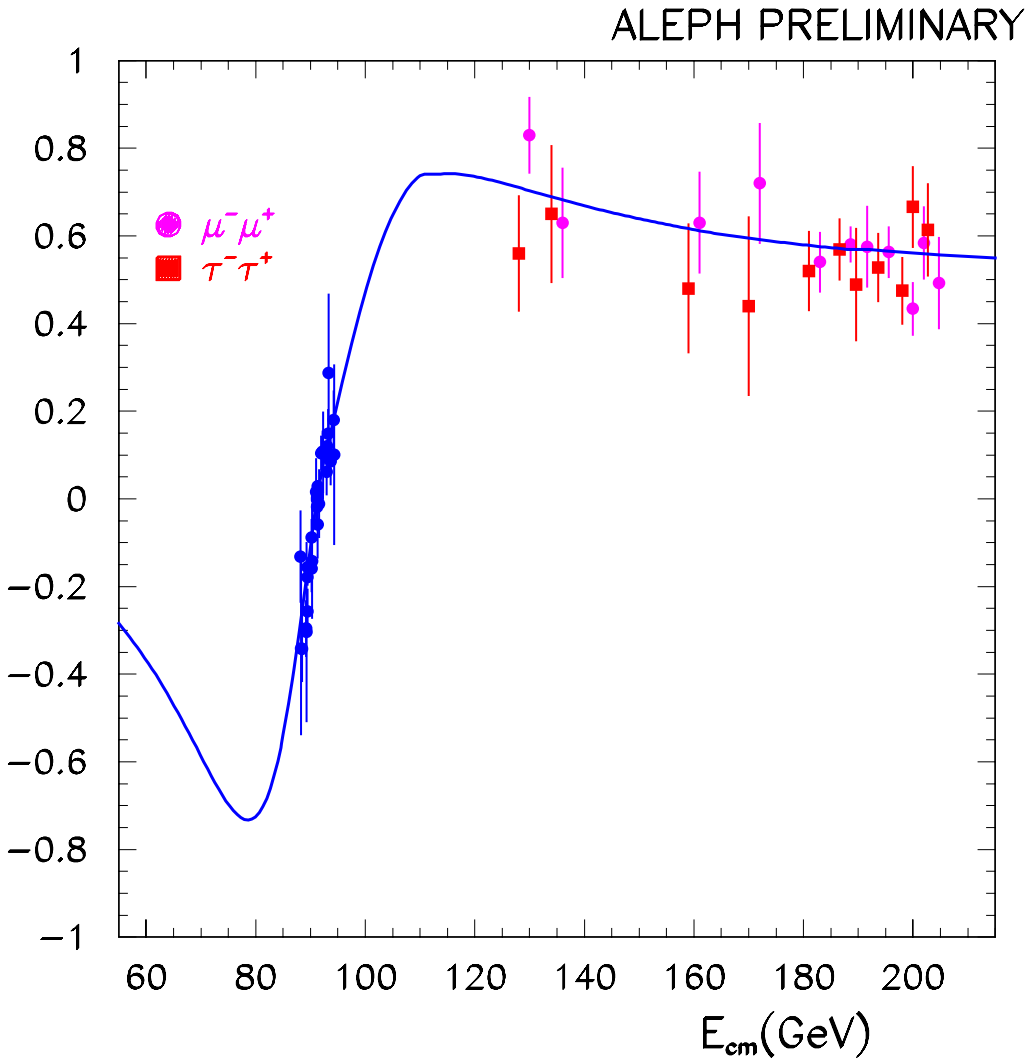
All results are PRELIMINARY

# *SM processes*

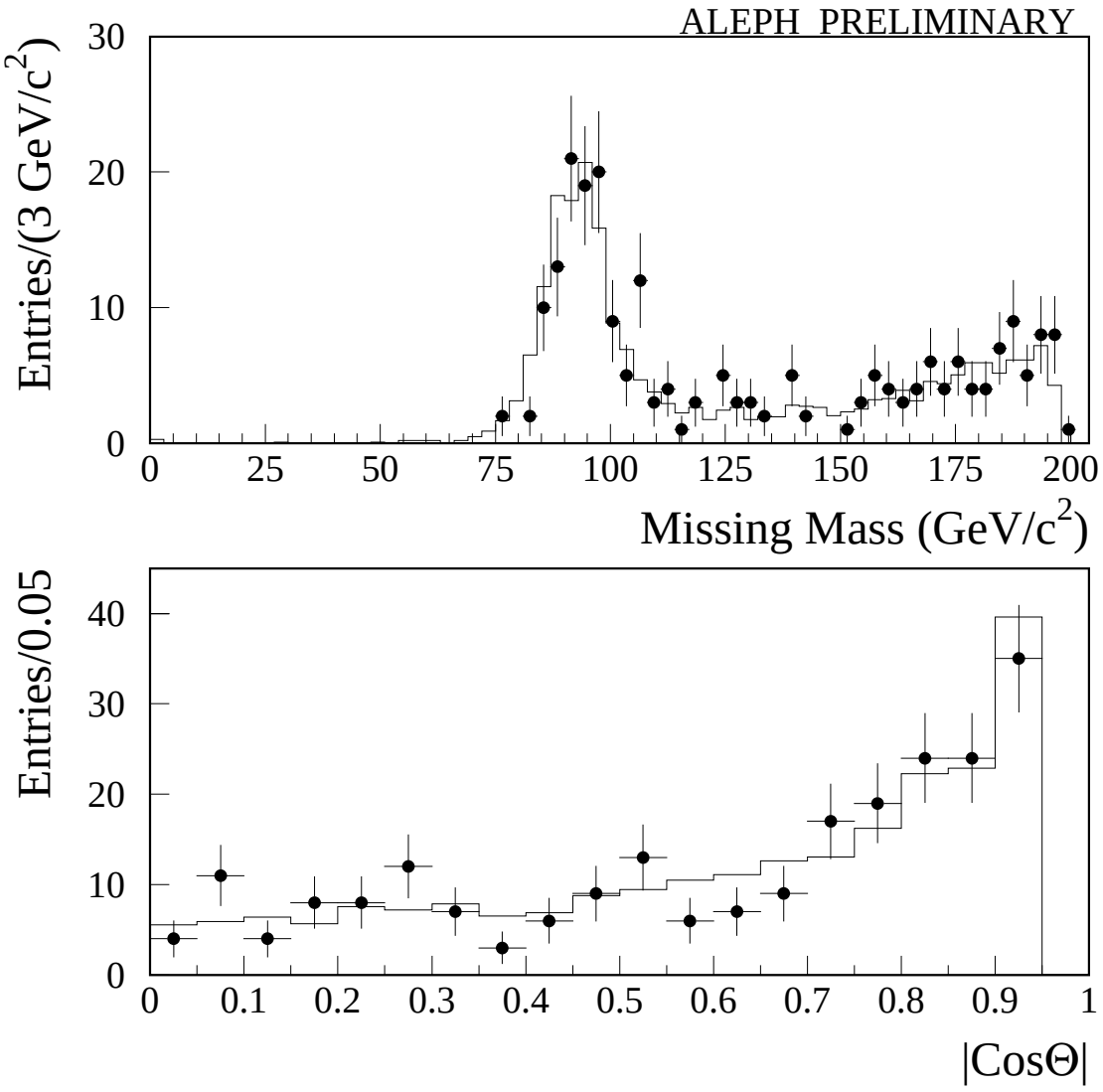
# 2-fermion cross sections



# *Lepton asymmetries*



# *Single photon + missing energy*

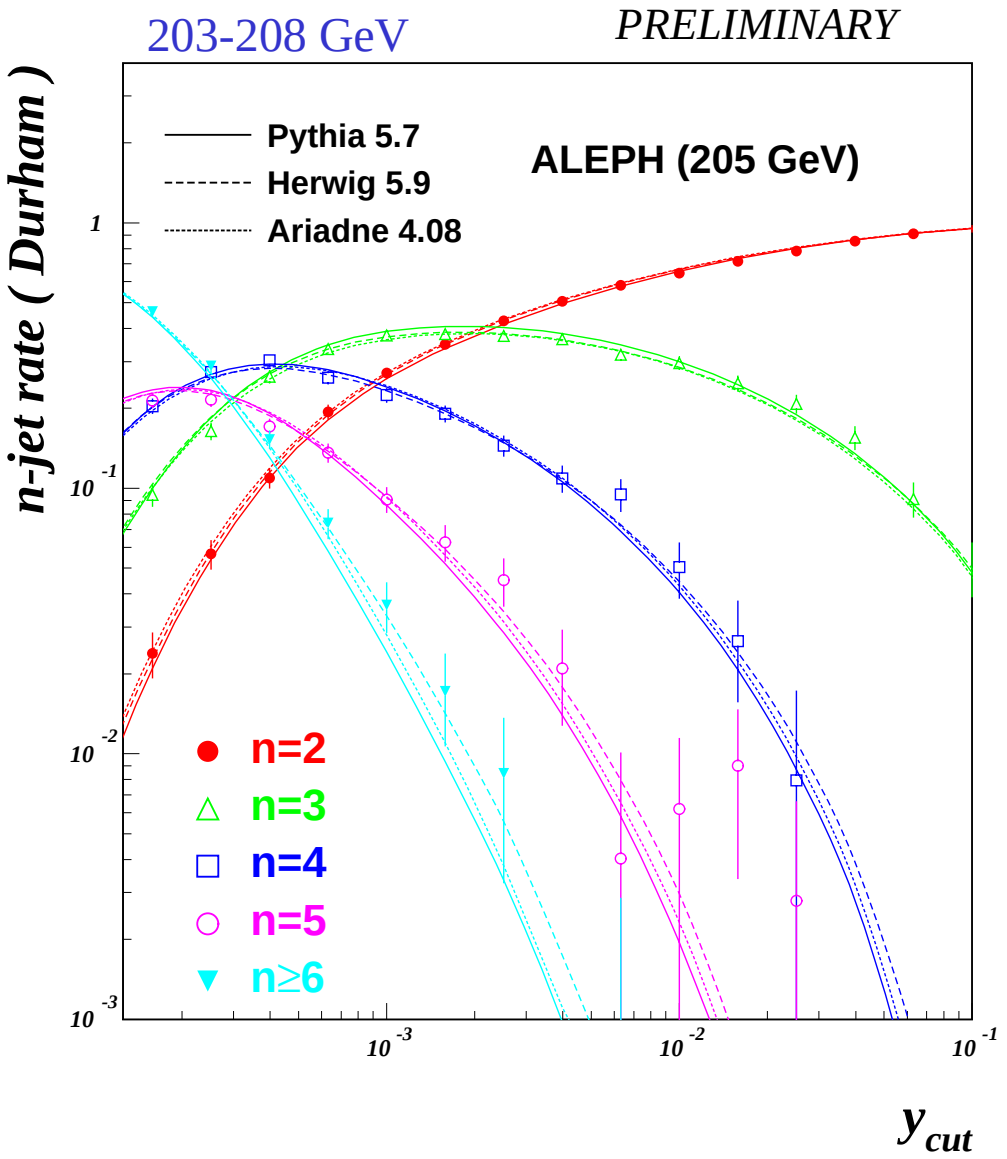



226 observed

c/w

226 expected

# QCD - Jet rates



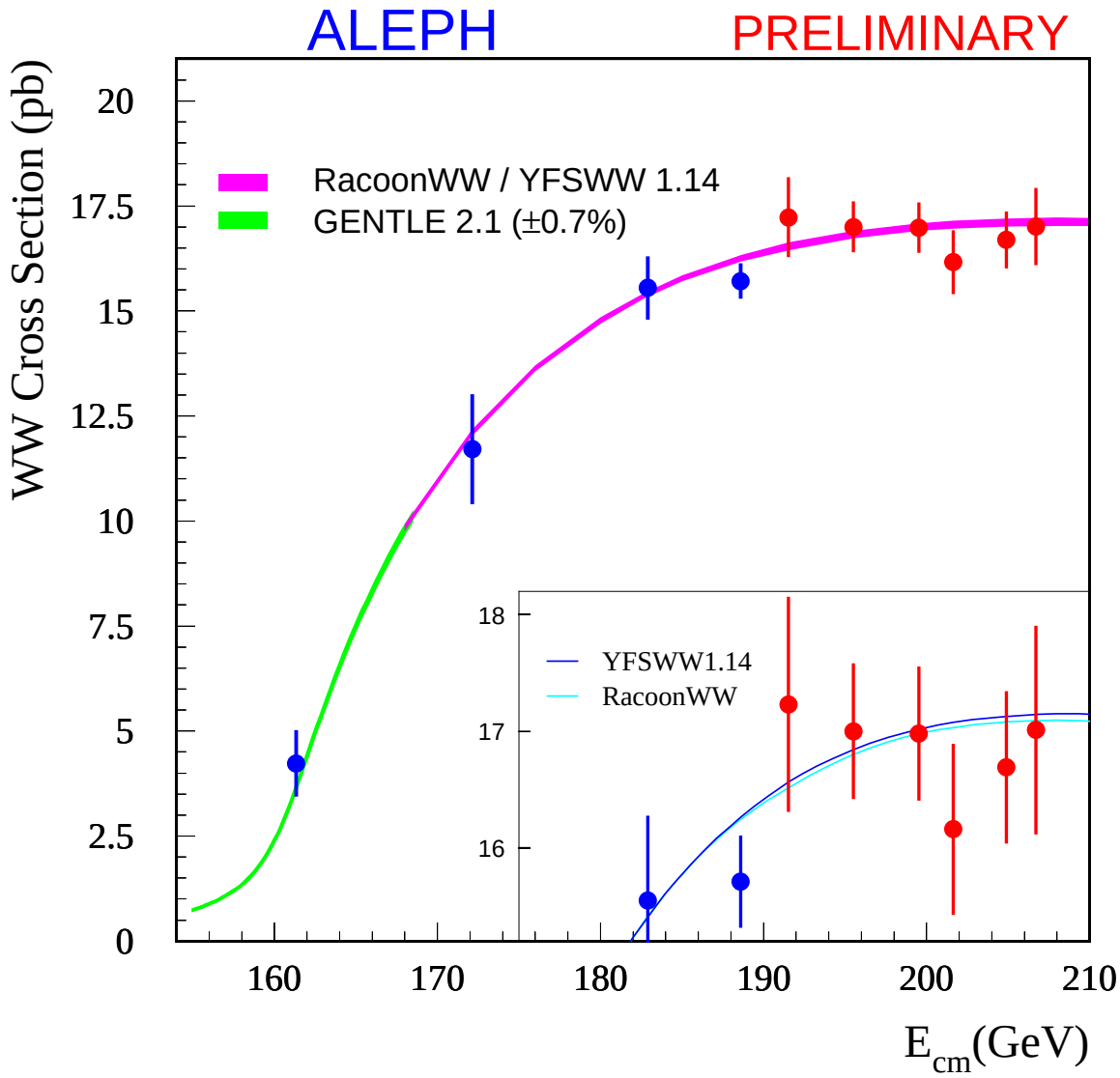
# *WW cross section*

At 204.9 GeV

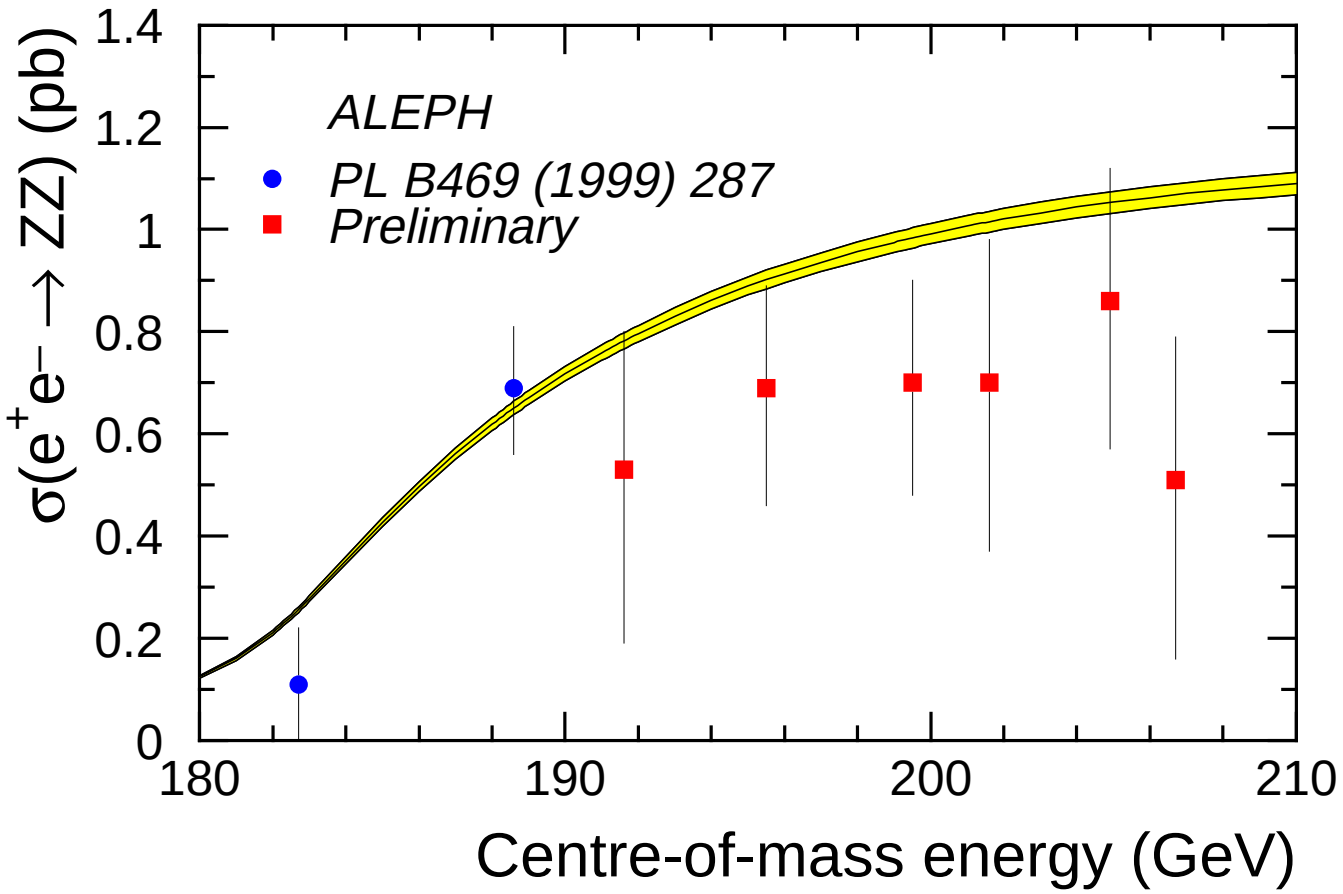
$\sigma^{WW}_{CC03} = 16.70 \pm 0.61$ pb

At 206.7 GeV

$\sigma^{WW}_{CC03} = 17.01 \pm 0.86$ pb

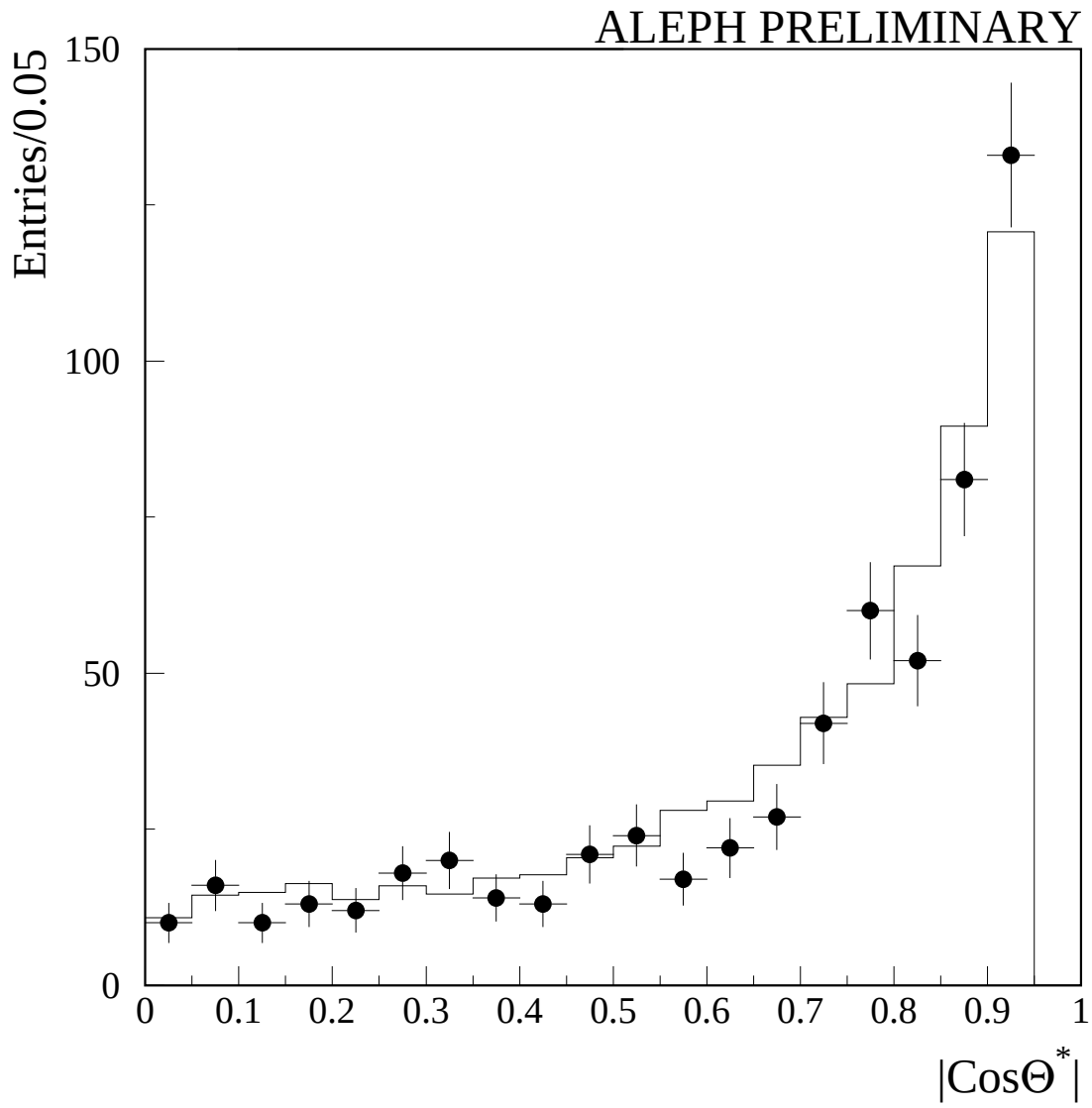


# ZZ cross section




$$\sigma(ZZ)/\sigma(ZZ_{SM}) = 0.79 \pm 0.09$$

# $\gamma\gamma$ production




605 observed

c/w

640 expected

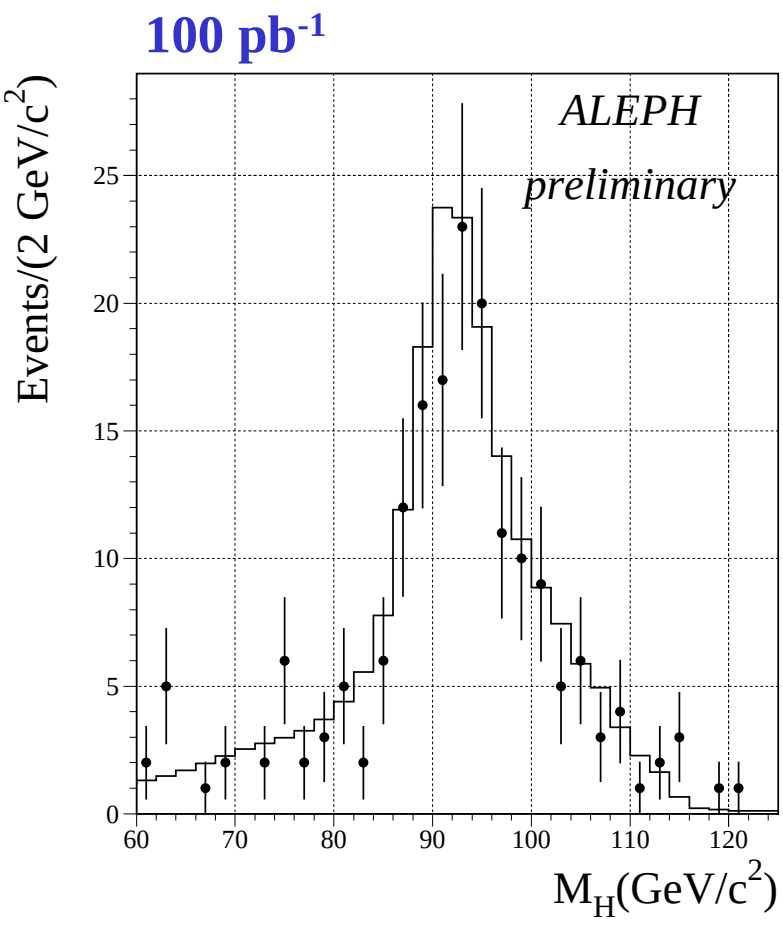
# *Higgs searches*

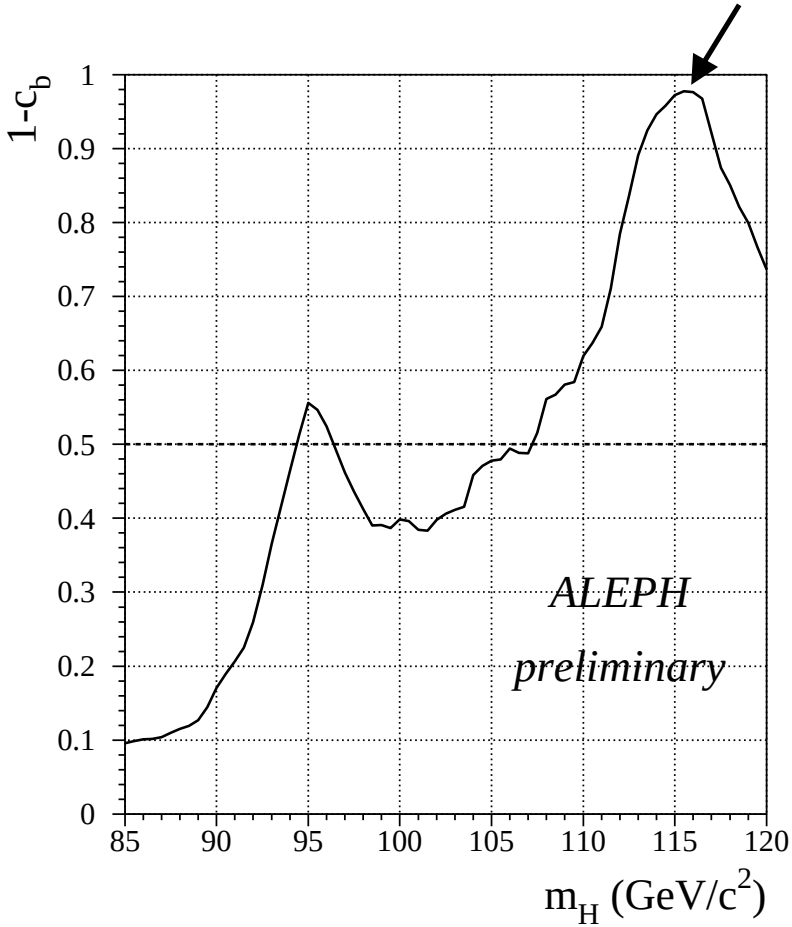
# SM Higgs

***84 observed c/w 82.7 expected***

**$C_b$= 0.02**

**100 pb$^{-1}$**



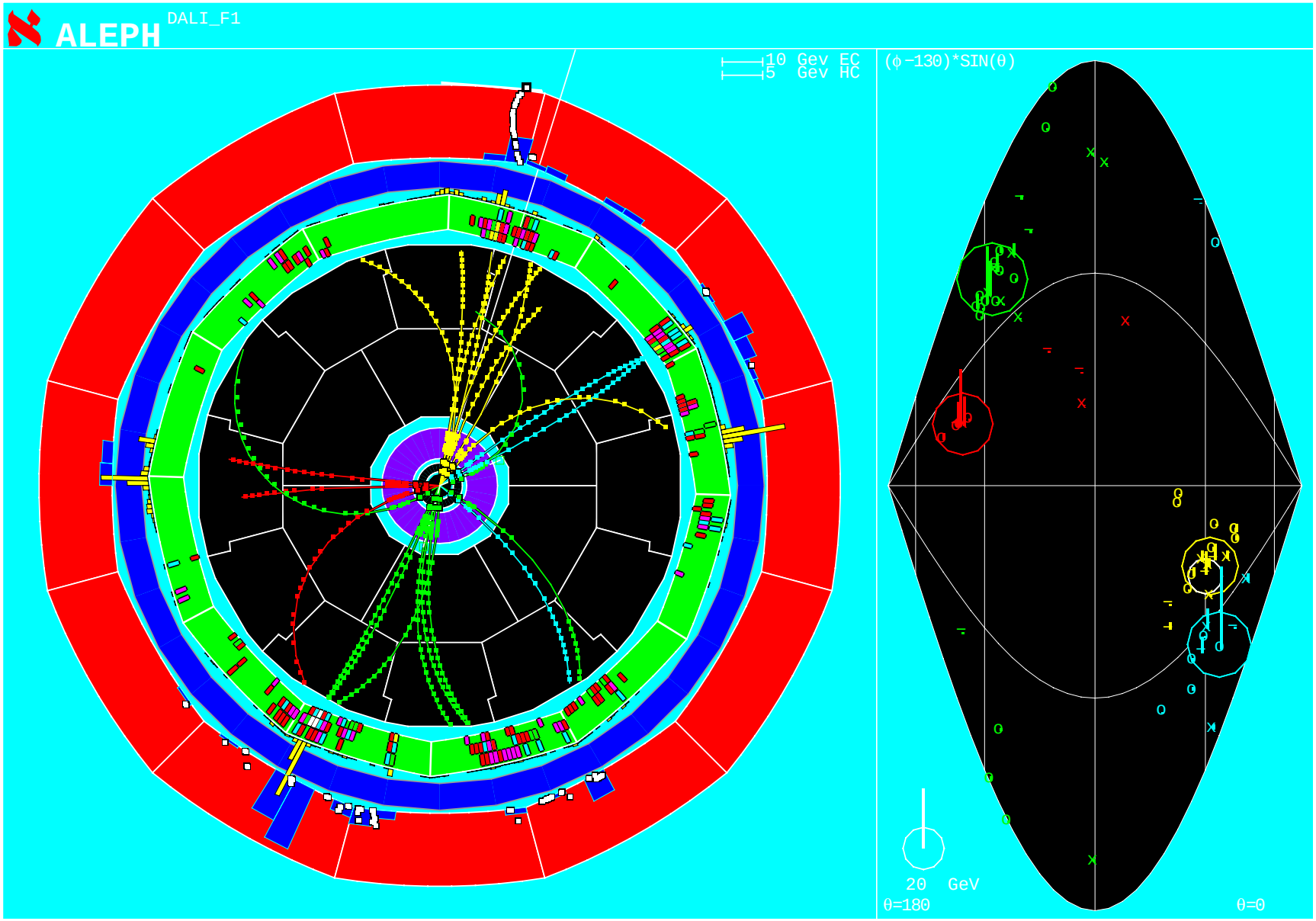

**Excess**

**SM**

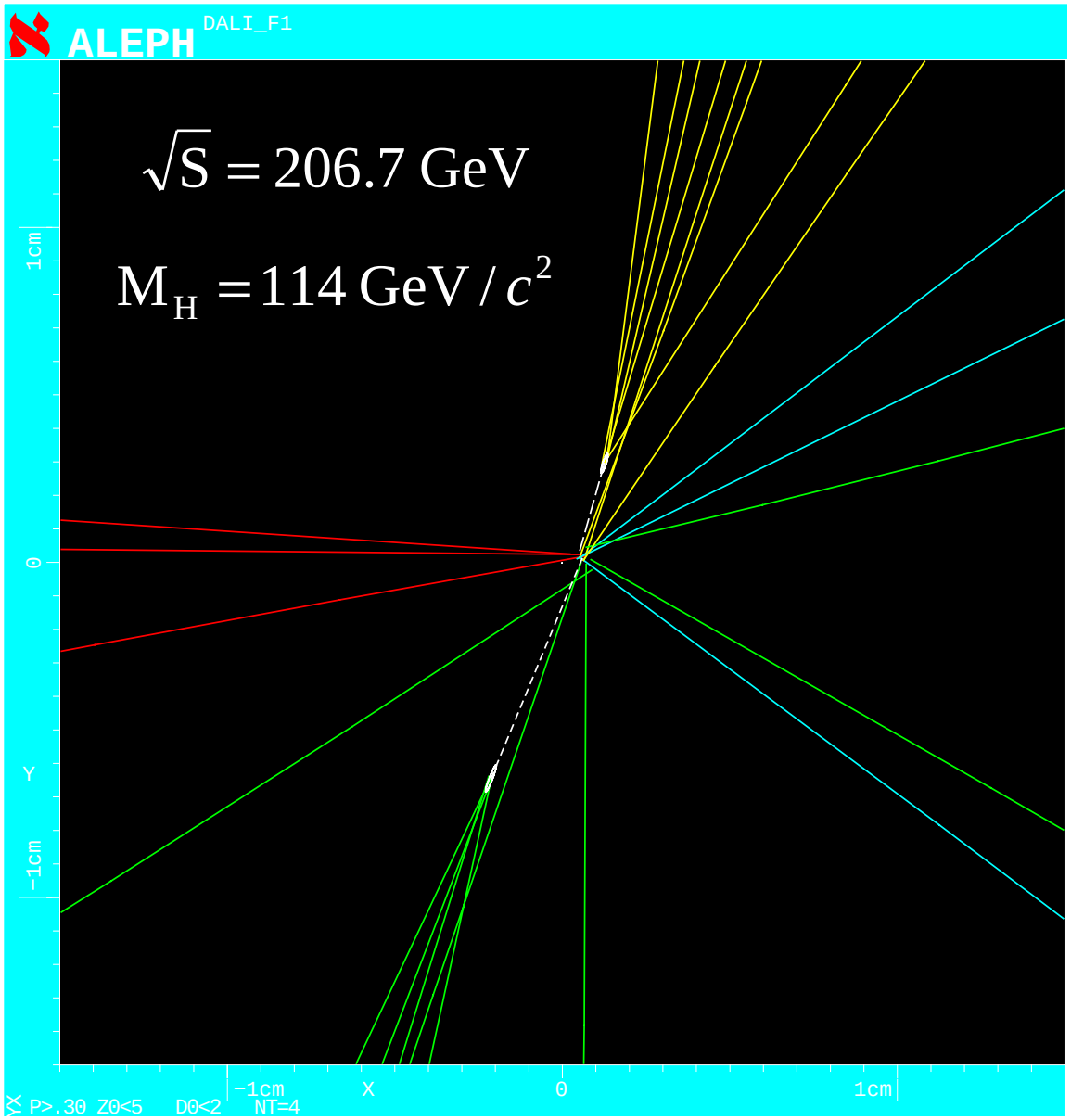
**Deficit**

$M_H > 111.1\ \mathrm{GeV}/c^2$ (112.3 GeV/$c^2$ exp)

# *SM Higgs bbqq candidate*



# *SM Higgs bbqq candidate - vertex region*



# *Fermiophobic Higgs*

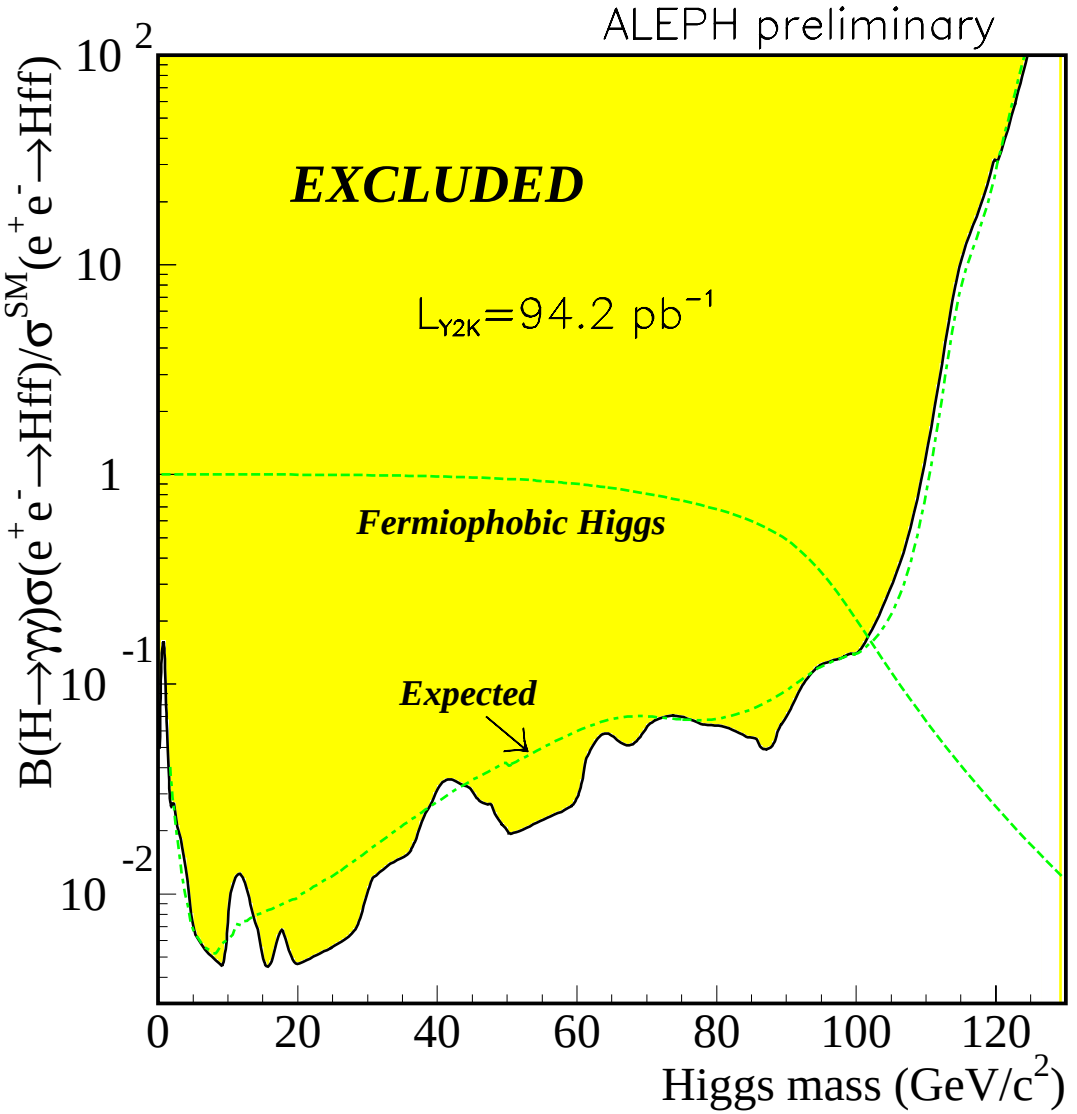
$e^+e^- \rightarrow HZ, H \rightarrow \gamma\gamma$

2 obs / 2.2 exp

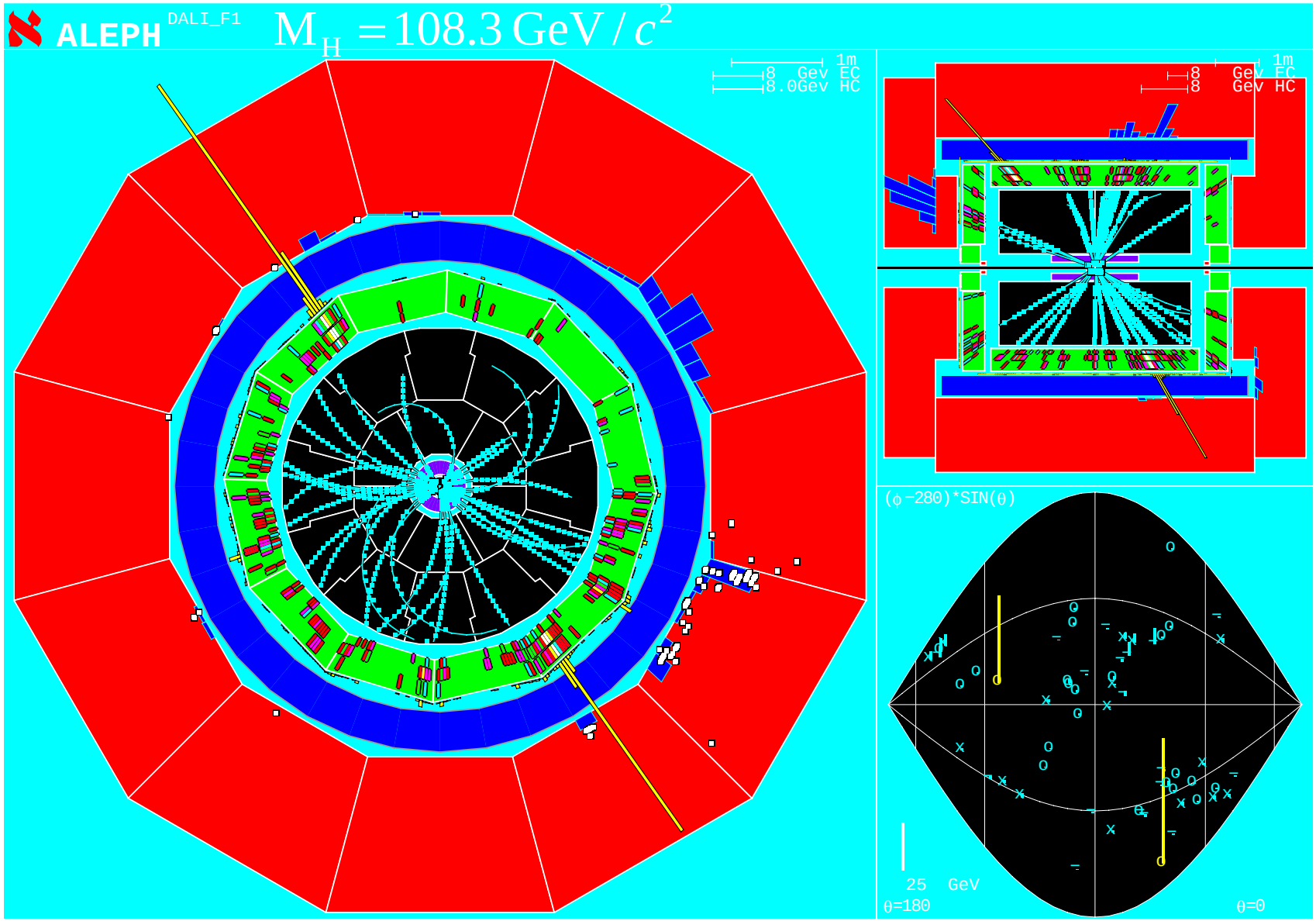
Fermiophobic Higgs

$M_H > 101.7$ GeV/ $c^2$

(exp 102 .2 GeV/ $c^2$ )

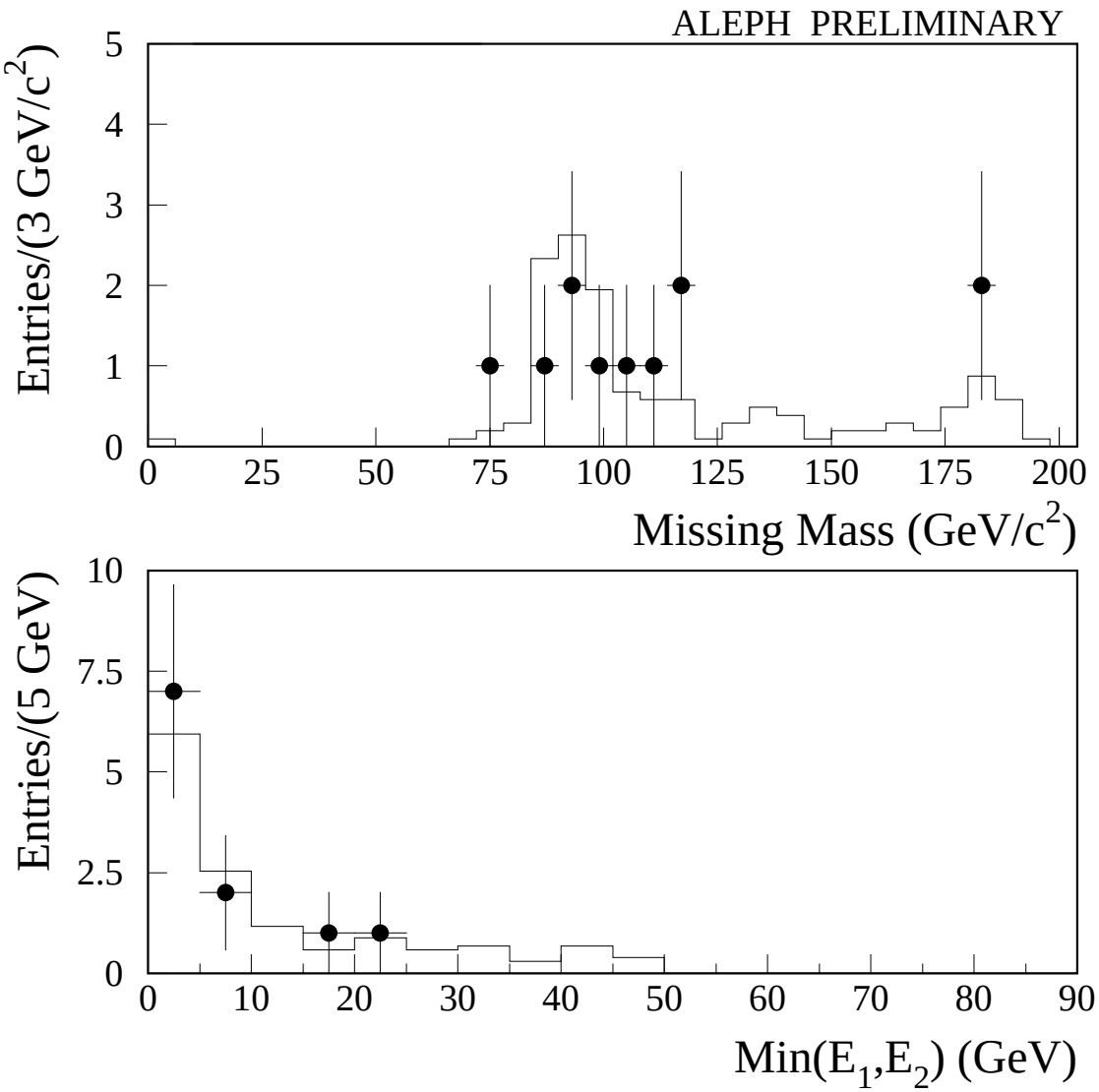


# *Fermiophobic Higgs candidate*



# *SUSY searches*

# GMSB: $\chi$ NLSP




$\gamma\gamma$ + missing E

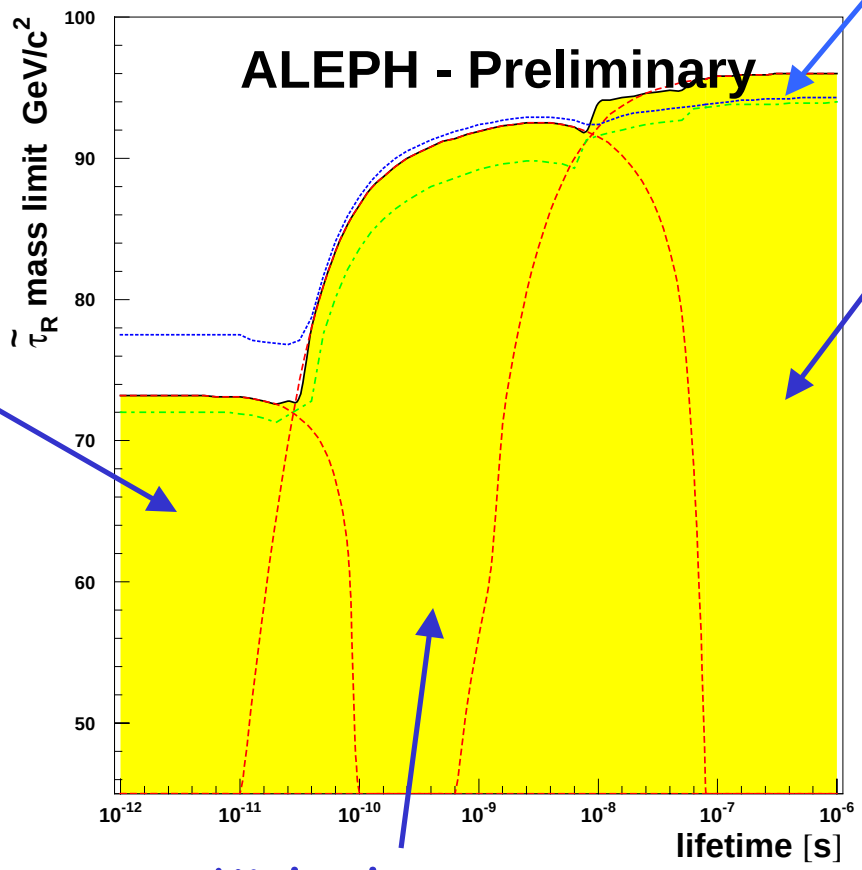
| | # obs | # exp |
|---|---|---|
| preselection | 10 | 8.2 |
| GMSB | 0 | 0.7 |

(E>36 GeV)

$M_{\chi} > 97$ GeV/ $c^2$

# GMSB: $\tilde{\tau}$ NLSP

Three search topologies depending on $\tau_{\tilde{\tau}}$




Expected limit

Stable heavy leptons (0 obs/ 0.6 exp)

Acoplanar leptons

Kinks, large impact parameter (0 obs/0.3 exp)

Lifetime independent mass limit

$$M_{\tilde{\tau}_R} > 73 \text{ GeV}/c^2$$

# RPV - UDD results

| Search | SUSY signal | #exp events | # obs events |
|---|---|---|---|
| 4 broad jets* | $\tilde{q}$ | 59 | 58 |
| 4 jets* | $\chi^+, \chi$ | 355 | 353 |
| Many jets | $\chi^+, \chi$ | 4.5 | 4 |
| Many jets + lepton | $\chi^+, \chi$ | 8.6 | 11 |
| 4 jets + 2 leptons | $\tilde{\ell}$ | 2.4 | 3 |
| Many jets + 2 leptons | $\tilde{\ell}$ | 3.3 | 3 |
| 4 jets + $E_{miss}$* | $\tilde{\nu}$ | 38 | 33 |
| Many jets + $E_{miss}$* | $\tilde{\nu}$ | 36 | 40 |

* sliding mass cut

# RPV - LQD results

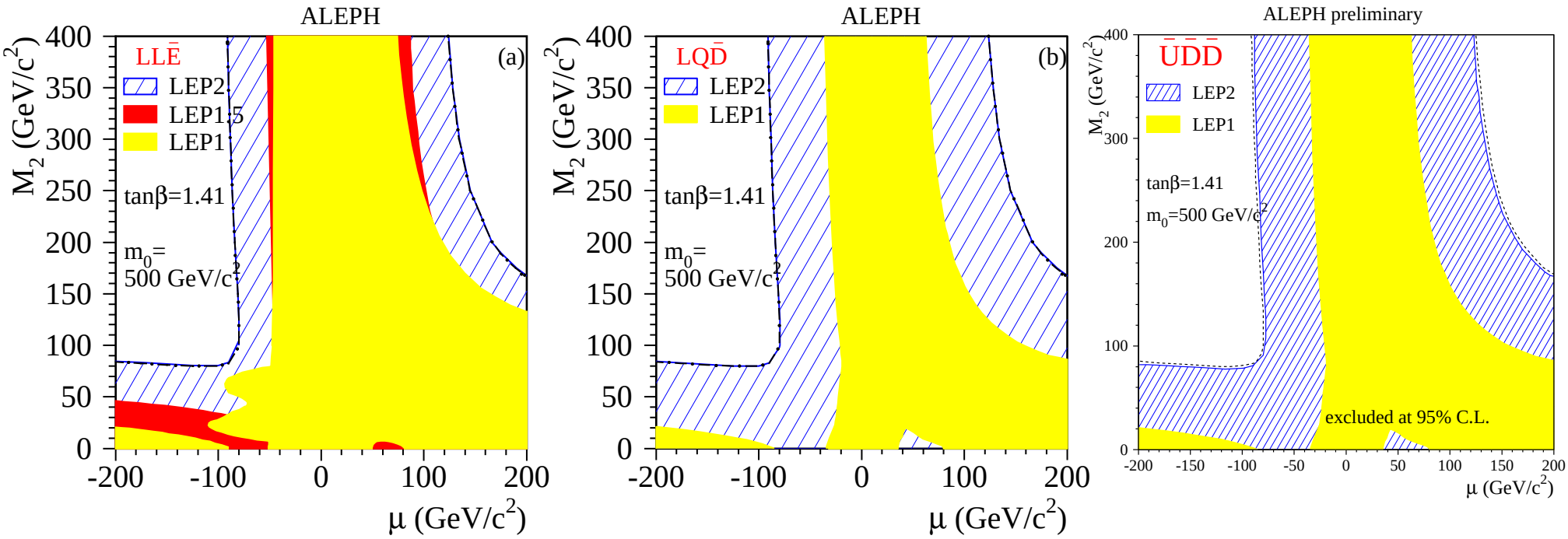
| Search | SUSY signal | # exp events | # obs events |
|---|---|---|---|
| Multijets +leptons | $\chi^+$ | 5.8 | 7 |
| 2 jets + 2 Taus | $\tilde{q}$ | 5.5 | 6 |
| 2 jets + $E_{miss}$* | $\tilde{q}$ | 11.3 | 16 |
| 4 jets | $\tilde{\ell},\tilde{\nu}$ | 395 | 378 |

# RPV - LLE results

| Search | SUSY signal | # exp events | # obs events |
|---|---|---|---|
| Leptons + hadrons | $\chi^+$ | 4.4 | 4 |
| 4 leptons | $\tilde{\nu}$ | 2.9 | 1 |
| 2 leptons + 2 taus | | 0.9 | 0 |
| 4 taus | | 2.0 | 0 |
| Acoplanar leptons | $\tilde{\ell}$ | 100. | 92 |
| 4 leptons + $E_{miss}$ | | 3.4 | 0 |
| 6 leptons + $E_{miss}$ | | 0.6 | 0 |

# *RPV : $\mu$–$M_2$ exclusion limits*

## *RPV Charginos excluded up to kinematic limit*



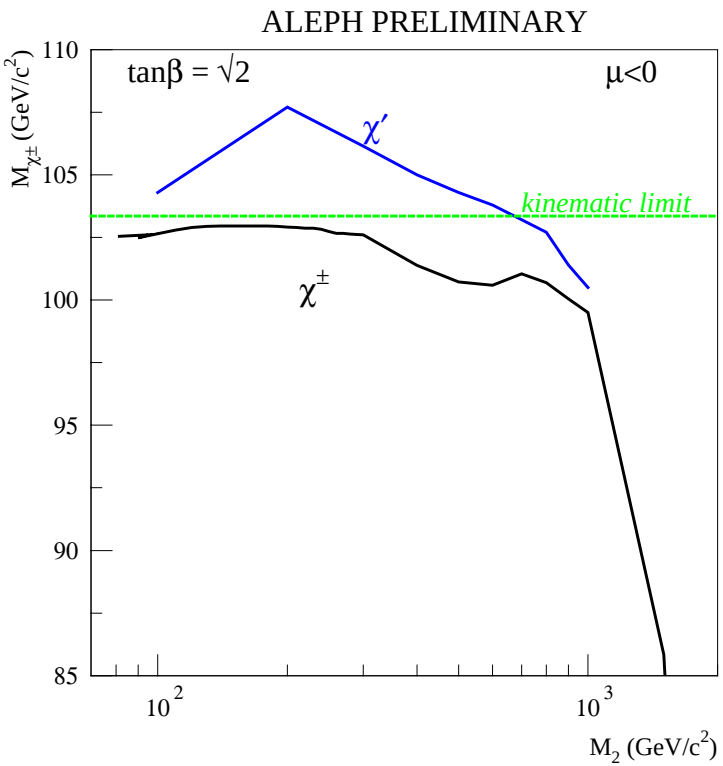
# Charginos + Neutralinos

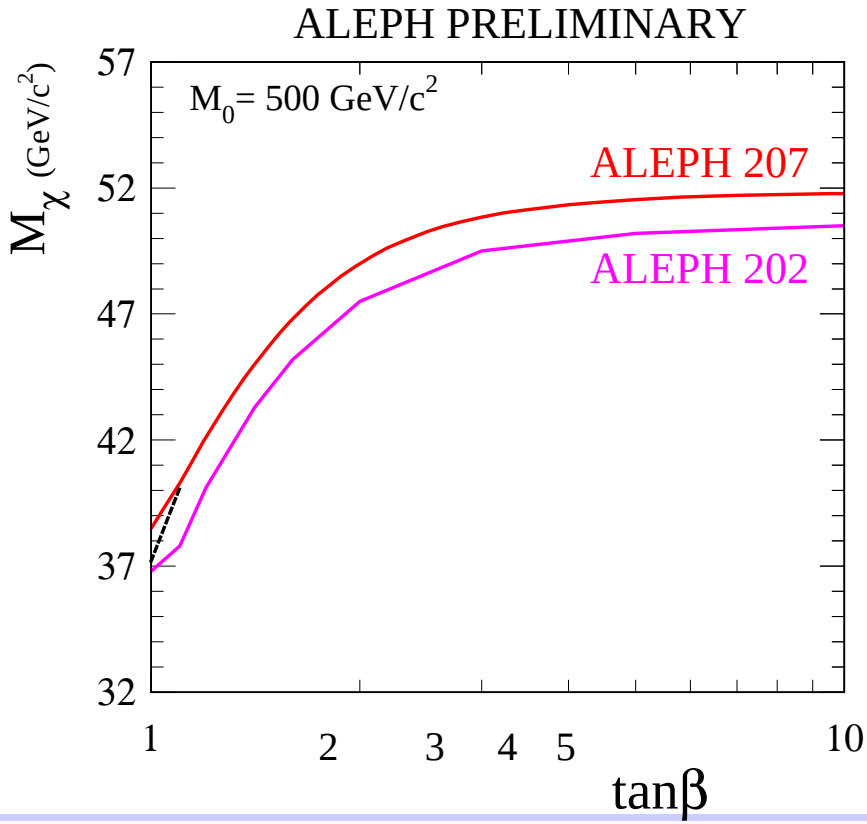
| Channel | # exp | # obs |
|---|---|---|
| $\chi\chi'$ | 1.2 | 1 |
| $\chi^+\chi^-$ | 4.5 | 6 |

**For large $M_0$**

$M_{LSP} > 37.2\ GeV/c^2\ (\chi^{\pm})$

$M_{LSP} > 38.5\ GeV/c^2\ (\chi^{\pm}, \chi)$

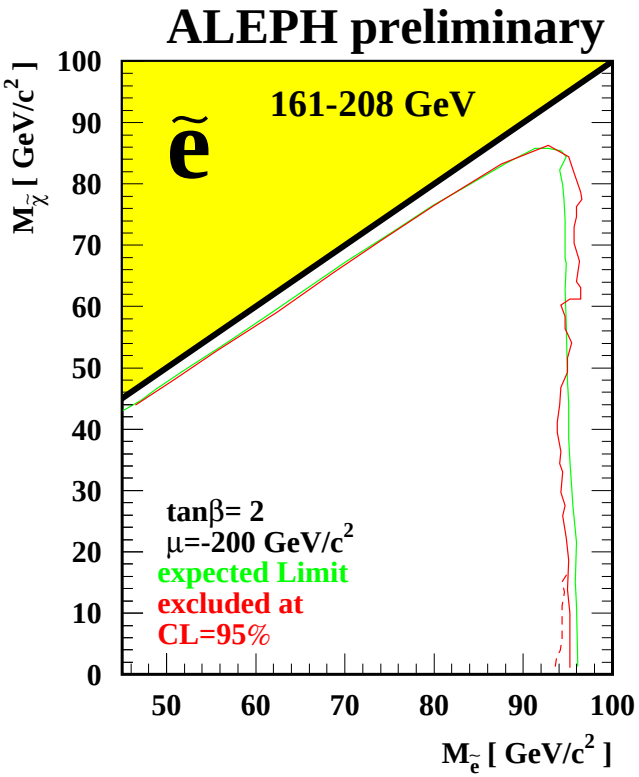


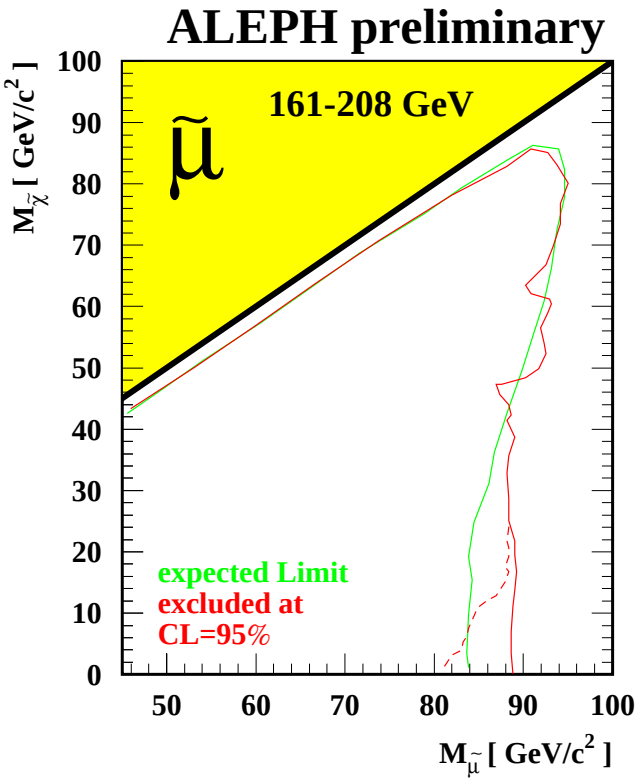



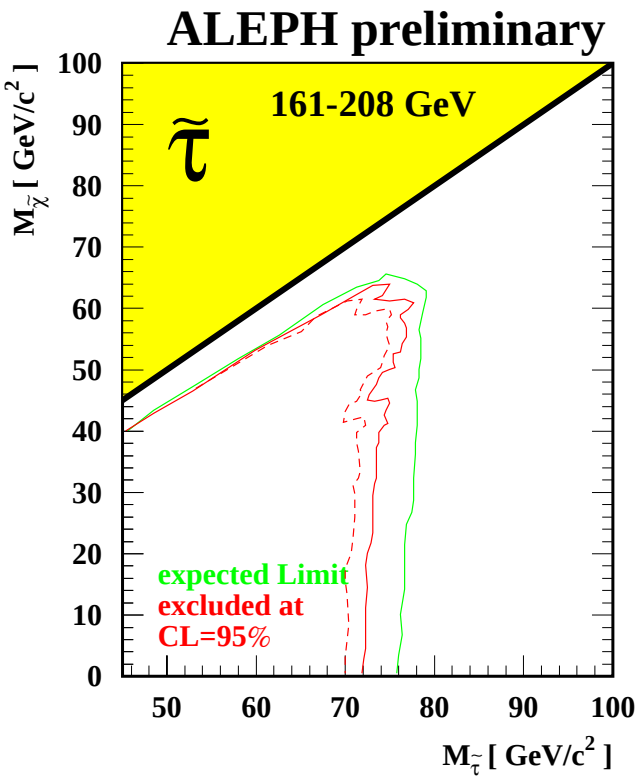
# Sleptons

High ΔM →

| Channel | # expected events | # observed events | Limit (GeV) At $M_\chi$=0 |
|---|---|---|---|
| ee | 18.4 | 20 | 95 |
| μμ | 16.5 | 19 | 88 |
| ττ | 10.0 | 10 | 72 |

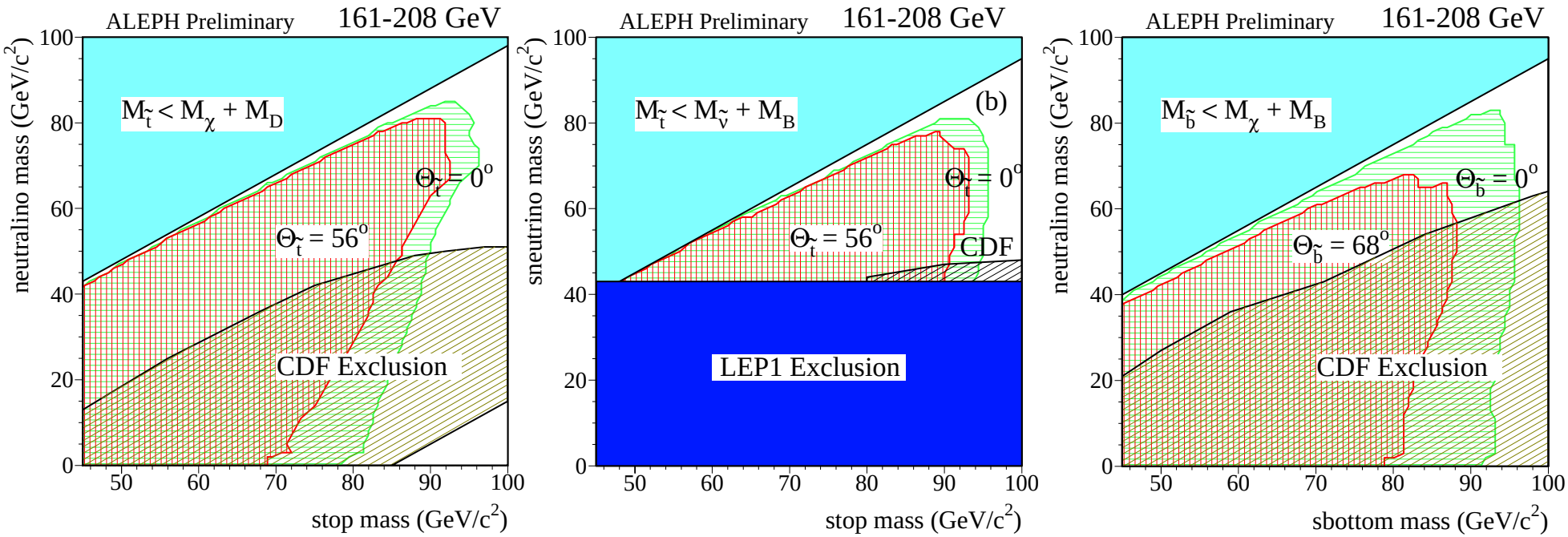


# Squarks

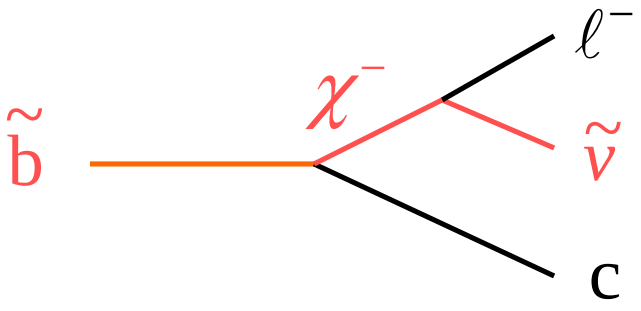
| Channel | # expected events | # observed events |
|---|---|---|
| $\tilde{t} \to c\chi$ | 5.2 | 7 |
| $\tilde{t} \to b\ell\tilde{\nu}$ | 0.7 | 1 |
| $\tilde{b} \to b\chi$ | 1.1 | 2 |



# *Light sbottom search*

**As as result of a communication from CDF**

Search for $e^+e^- \rightarrow \tilde{b}\bar{\tilde{b}}$,

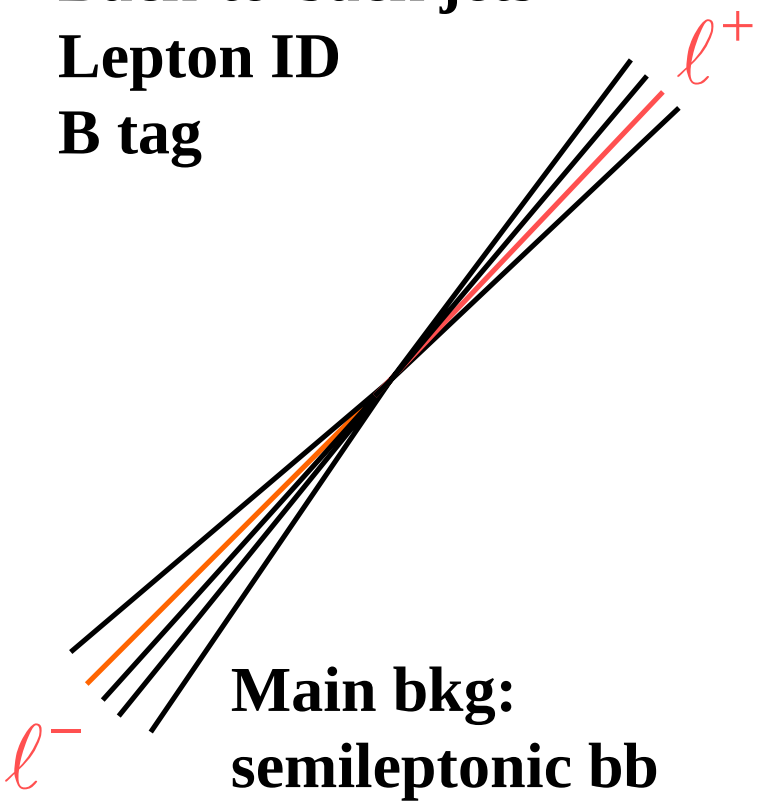



with,

- $M_{\tilde{b}} \approx 4\,\mathrm{GeV}/c^2$
- $M_{\tilde{\nu}} \approx 0\,\mathrm{GeV}/c^2$
- $\tau_{\tilde{b}} \approx 1\,\mathrm{ps}$
- $B(\tilde{b} \rightarrow c\mu^-\tilde{\nu}) = B(\tilde{b} \rightarrow ce^-\tilde{\nu}) = 0.5$
- $\tilde{b}$ and $\tilde{\nu}$ mix and decouple from the Z

# *Selection at LEP2*

**Back-to-back jets**
**Lepton ID**
**B tag**




**Main bkg:**
**semileptonic bb**

**Cuts:**

- **hadronic preselection**
- **2 opposite sign charged leptons**
- **acoplanarity < $8^0$**
- **$E(l_1)>0.2*ELEP$, $E(l_2)>0.1*ELEP$**
- **$|\cos\theta_{thrust}| < 0.7$**
- **$\log(P_{uds}) < -1.7$**

**Efficiency = 27%**
**Background: ~100% qq**
**78% bb**
**18% cc**
**4% uds**

# *Results*

| ELEP (GeV) | L($pb^{-1}$) | #exp | # obs |
|---|---|---|---|
| 161 | 11 | 0.7 | 1 |
| 172 | 11 | 0.7 | 4 |
| 183 | 59 | 3.6 | 9 |
| 189 | 174 | 10.7 | 19 |
| 192 | 29 | 1.7 | 1 |
| 196 | 80 | 4.4 | 6 |
| 200 | 86 | 4.6 | 8 |
| 202 | 42 | 2.5 | 5 |
| 205 | 94 | 4.7 | 3 |
| **Total** | 586 | 33.6 | 56 |
| Same sign | 411 | 24.0 | 27 |

($Eff_{sbottom}$=1.5%)

# *Status*

Probability of such a fluctuation $=2.5\ 10^{-4}$

Including 10% systematics $=2\ 10^{-3}$

Analysis is very new

Details given to LEP SUSYWG

Statistics not a problem at sbottom factories

# *Running requests*

1. To run immediately in a mode which will give maximum luminosity
   at the highest energy - assumed to be 2 x 2.

2. To take at least 10 $pb^{-1}$ at the highest energy using the reserve if necessary.

3. Continue to take data at high energy after the scheduled end of run
   until such time as the Higgs reach for a 3 sigma discovery,
   estimated on the basis of a three month continuation,
   is excluded at 95% confidence level.

4. If point 3 is reached before the end of September the collaboration
   considers that a dedicated run of 200$pb^{-1}$ for the W mass at threshold
   will provide an excellent increase in the accuracy of the measurement
   of this fundamental parameter

5. A 0.5 $pb^{-1}$ calibration run at the Z peak at the end of the run

6. Energy calibration should be a priority

# *Conclusions*

**All standard searches performed on 93 pb-1 @ 203-208 GeV**

**Good agreement with SM predictions**

**No evidence of new physics at high energy**

**Cannot rule out light sbottom production**

**Two good high mass Higgs candidates observed**
**(1 SM, 1 fermiophobic)**

**Congratulations to LEP operations and RF groups!**